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The Laptev walrus

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The Laptev walrus (*Odobenus rosmarus laptevi* Tschpski, 1940) is one of the three subspecies of the walrus. It was included in the Red Book of the USSR as a rare endemic subspecies which is potentially vulnerable because of its low numbers, limited range and increasing anthropogenic stress (category III).

The range of the Laptev walrus takes in the Laptev Sea, the eastern part of the Kara Sea and the western regions of the East Siberian Sea (Fig. 1). In the central part of the range (Laptev Sea), the walrus spends winter and spring in the ice of flaw polynyas. The pups are born there too. Aerosurveys show that recurring polynyas are found in two areas of the Laptev Sea, in its western part near the M. Taimyr—Bolshevik islands and south of Cape Chelyuskin, and in its eastern part northwest of Kotelnyi Is. (Fig. 1). Small groups of walruses overwinter in the holes maintained by them, predominantly in the areas of frequent shearing and formation of fractures (Vilkitsky Strait). In summer, when the ice retreats northward to the deeper areas, the animals leave the ice and haul out on the shores. In the western sector of the Laptev Sea, we know of hauling-out grounds in M. Pronchishchevaya Bay, and on the Faddei, Andrei, Pyotr, Peschany,

Preobrazheniye and B. Begichev islands. All of these hauling-out grounds are found on sandy or sandy-pebbly sand bars of islands or the mainland coast in shallow areas with a silty bottom substrate (Popov, 1960).

The existence of a sea rookery on the northern sand bar (Morzhovaya Kosa) at the entrance to M. Pronchishchevaya Bay (Fig. 1) was first noted in 1912 by Dr. Starokadomsky during the expeditions of the "Taimyr" and "Vaigach" icebreakers. A hunting station was set up there in the autumn of 1933, and walrus hunting was carried on for four seasons in the waters of the bay and on Morzhovaya Kosa, the hunt being undertaken not at the end of the shore season, but 2—4 days after the hauling-out of the first walruses. During the1935—1936 season, zoologist L.N. Popov spent the winter at the hunting station; he collected data on the biology of the walrus, which was based primarily on the analysis of selective commercial catches of this animal. The rookery decreased with each year, but despite this, the hunting continued; as a result, not a single animal hauled out on the sand bar in 1937 (Popov, 1939). Only sparse random data obtained from pilots and workers of the polar station are available on the postwar existence of this rookery.

We conducted observations in M. Pronchishchevaya Bay from 15 July up to 10 September 1984, and from 4 August up to 10 October 1985. Before the walruses approached the shore, we observed the animals in the water and on pack ice (up to 5 km from the shore) from traverse routes located from the base of the sand bar along the coastline northward (10 km) and along the northern shore of the bay (5 km). On the days when the first highly cautious walruses approached the deserted sand bar, we observed the animals from the main shore from a distance of 1 km. From the moment the rookery began to form, we conducted observations 2—4 times a day from a distance of several metres up to 80—100 metres. The observations lasted from 4 to 12 hours a day, a total of about 400 hours. In 1984, we conducted 8 observations at night, mainly at the end of August—beginning of September, when the sun at night began to sink beyond the horizon. For each animal or group of animals, we noted the time of their approach and their behavior in the water and at the rookery. All the animals that approached the sand bar one after another at intervals of less than 7 minutes were regarded as members of the same

group. Special note was made of animals with natural markings. Meteorological data for the whole period were obtained from the meteorological station 5 km away from the sand bar.

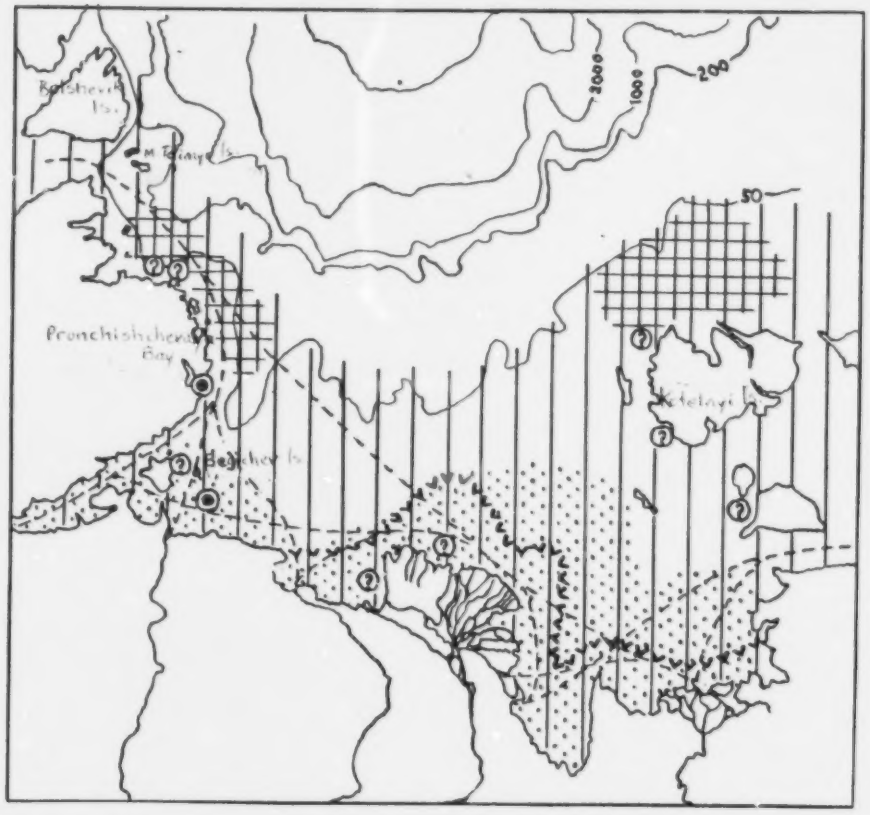

Fig. 1. Range of the Laptev walrus

— n— - depths in metres

vvvvvv - boundary of maximum distribution of ice during the period of minimum development (September)

- areas of walrus distribution during the summer and autumn

- areas of aggregation and reproduction of the walrus during the winter and spring

⊙ - surveyed shore and island rookeries at which walruses hauled out in 1984 and 1985

(?) - supposedly existing rookeries

- area of water pollution

– – – – – - main navigation routes

Seasonal population dynamics of the walrus at the rookery. In 1984, the first walruses in the vicinity of Morzhovaya Kosa were noted on the ice at quite a distance from the shore (over 5 km) on 18 July, the day when the fast ice was completely destroyed from the seaward side of the sand bar. The number of animals observed in the vicinity of the sand bar gradually increased, and at 18.00 hours on 27 July, we noted the first attempts of the walruses to haul out on the sand bar from the side of the bay. Individual walruses made no attempt to haul out. Groups of 2—6 adult animals approached the water line. During the first haul-out, the walruses displayed extreme caution. Each group made at least three attempt to haul out; the animals raised themselves high on their front flippers, surveying the sand bar and constantly sniffing. Advancing slightly onto the shore, they turned about and went back into the water, then almost immediately made another attempt to haul out. At 03.30 on 28 July, several of the first groups of walruses numbering 17 animals in all hauled out on the shore. From that moment on, the number of walruses at the rookery began to increase rapidly; by 19.00 hours, there were already 150 of them. When the first group of walruses had formed the rookery, the rest of the animals approaching the sand bar began to behave quite differently; seeing the animals lying on the sand bar, they quickly swam to the hauling-out point, and without hesitation, only slightly sniffing the pebbles bearing walrus prints, advanced towards the rookery. Four days passed from the time the first walruses appeared at the sand bar (24 July) to the time the rookery was formed (28 July).

In 1985, the rookery was formed slightly later. The first pair of walruses was noted in the sea not far from the sand bar only on 9 August. The number of walruses increased more slowly, and the rookery was formed only on 23 August, i.e. 14 days later.

The composition of the walrus groups that approached the sand bar first was approximately the same both in 1984 and 1985; they were predominantly adult animals, and the first attempts to haul out were made by the male animals.

The differences in the periods of onset of the shore season in 1984 and 1985 were apparently due mainly to different meteorological and ice conditions. In 1984, for example, the high temperature in July and strong

offshore winds led to a quick break-up of the fast ice, and the concentration of the pack ice decreased from 10 to 5 points within a week. As a result of this, the walruses could travel along the eastern coast of Taimyr with relative ease, and they hauled out at the end of July. In 1985, a decrease in the concentration of pack ice to 5 points and the appearance of clean water took place a month later, and the walruses hauled out a month later as well. During the three days the rookery was first forming in 1984 and 1985 (Figs. 2, 3), the weather was warm (12—17°C and 8—12°C at the soil surface) and almost windless (SSW-SSE up to 2 m/s and ESE-SSW up to 4 m/s).

Those studying the Pacific walrus have repeatedly noted that the coastal rookeries are formed when there is absolutely no ice left tens of kilometres from the shore. In 1984 and 1985, the shore period began under different conditions for the Laptev walrus, i.e. in the bay and adjacent water area, the amount of floating ice at a distance of up to 24 km reached 4 points, and the concentration of the ice varied from 2 to 6 points. Only after 10 days in 1984 and 8 days in 1985 did the quantity of floating ice decrease to 0—1 point, and several days later, individuals ice floes also appeared. Furthermore, ice recurred several times in the bay area throughout the shore season of the walruses. Canadian researchers noted a similar situation at the Atlantic walrus rookery on Bathurst Is. (Canadian Arctic); an abundance of pack ice was observed in the area of the island the entire period that the rookery existed (Salter, 1979).

During the 44 days of observation in 1984, the number of walruses on the shore repeatedly increased (up to 600 at the most), and then decreased (Fig. 2). During this period, eight clearly defined peaks of abundance were noted. Twice, the number of animals in the rookery remained almost stable for 5—6 days. On 26 August, all the animals left the sand bar, and on 28 August, the rookery began to form once again.

The number of animals on the sand bar was recorded by polar-station worker V.P. Petrova and hunter V.P. Pchelin from 10 September up to the end of the shore season of the walruses. According to their data, the walruses again left the rookery on 17—18 September (Fig. 2), and then from 29 September, when the strong offshore wind had died down and the sea was completely ice-free for tens of kilometres, the number of walruses

at the rookery began to increase rapidly, totalling over 2000 animals on 26 September. Several days later, the number of walruses decreased once again, and by the end of the second ten days of October, had completely left the sand bar. The shore season lasted about 85 days in 1984.

In 1985, we managed to observe the shore season of the walruses from beginning to end (Fig. 3). During this season, the rookery formed four times, due to the fact that the walruses left the sand bar three times after relatively short intervals (9—16 days). The maximum number of animals at the rookery was 600. The shore season was shorter than in 1984 (47 days).

It should be said that each reoccupation of the rookery got underway much more easily and quickly than the initial occupation, obviously because there was still a strong walrus scent on the shore and also because some of the animals hauling out first had already been at the rookery that season.

The results of the 1984 season were used to determine the individual coefficients of correlation between the meteorological and ice conditions on the one hand, and the fluctuations of the walrus numbers at the rookery on the other. The ice played an important role; with an increase in the quantity and concentration of the pack ice in the water area adjacent to the bay, the abundance of walruses at the rookery decreased (individual coefficient of correlation $r = -0.47$, $P<0.01$). On the days when pack ice abounded in the adjacent water area, not more than 150—200 walruses remained on the sand bar, even with all other factors being favorable.

The walruses were highly responsive to the changes in atmospheric pressure; the latter dropped sharply three times during the season, and the majority of the animals left the rookery. For this factor, we can calculate the coefficient of correlation for both the whole season ($r = 0.32$, $P<0.05$), and the 22 days when there was practically no pack ice ($r = 0.56$, $P<0.01$). In the first case, with variable ice conditions, the coefficient of correlation between the fluctuations in atmospheric pressure and the abundance of walruses on the shore was nearly 50% lower. This is due to the fact that the animals react to a complex of environmental factors, and the effect of each of these can be singled out only arbitrarily.

Concentration of floating ice at a distance of up to 24 km from shore, points									
2-9	2 - 6	0 - 3	0	0	0 - 8	0 - 3	0 - 6	0	0
Prevailing wind: direction / velocity (m/s)									
N /3,I	NNW/6,0	N/5,0	N /5,3	NNW/7,5	SE/2,9	N /5,7	SSE/6,0	SSE/5,6	N/2,5
Maximum pressure drop over 24 hr during a period (mb)									
+4	-6	-II	-5	+6	-5	+9	+20	+6	-6
Average temperature (C^0)									
5,6	8,0	2,8	3,6	I,I	2,2	I,2	3,I	I,5	0,9
Occupancy of rookery (walruses/day)									
0	422	982	II64	826	7I2	362	848	704	I620

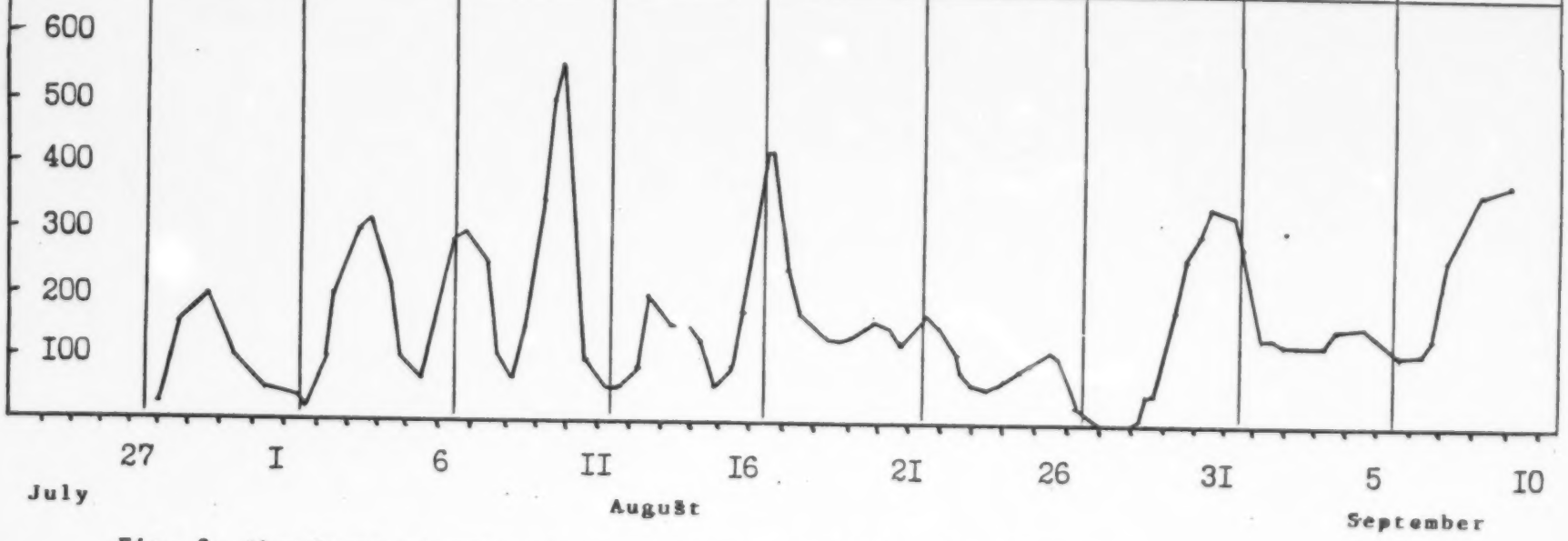

Fig. 2. Abundance of walruses at the rookery during the 1984 shore season

Concentration of floating ice within a distance of up to 44 km from shore, points									
2-7	0 - 2	0	0	0	I	I - 3	0 - I	0 - 3	3 - I0
Prevailing wind: direction / velocity (m/s)									
NNW/9,2	NNE/5,3	NNW/9,I	NNW/5,2	E/6,7	S/4,2	SSW/6,5	SSW/9,7	NNW/8,0	NNW/4,6
Maximum pressure drop over 24 hr during a period (mb)									
-6	4	I0	+3	-7	-7	+I2	-20	+I2	-6
Average temperature (C^0)									
4,3	0,6	-I,7	-0,I	-I,5	0,9	I,9	I,2	-5,8	-7,8
Occupancy of rookery (walruses/day)									
2I8	570	778	2II4	524	925	364	352	730	247

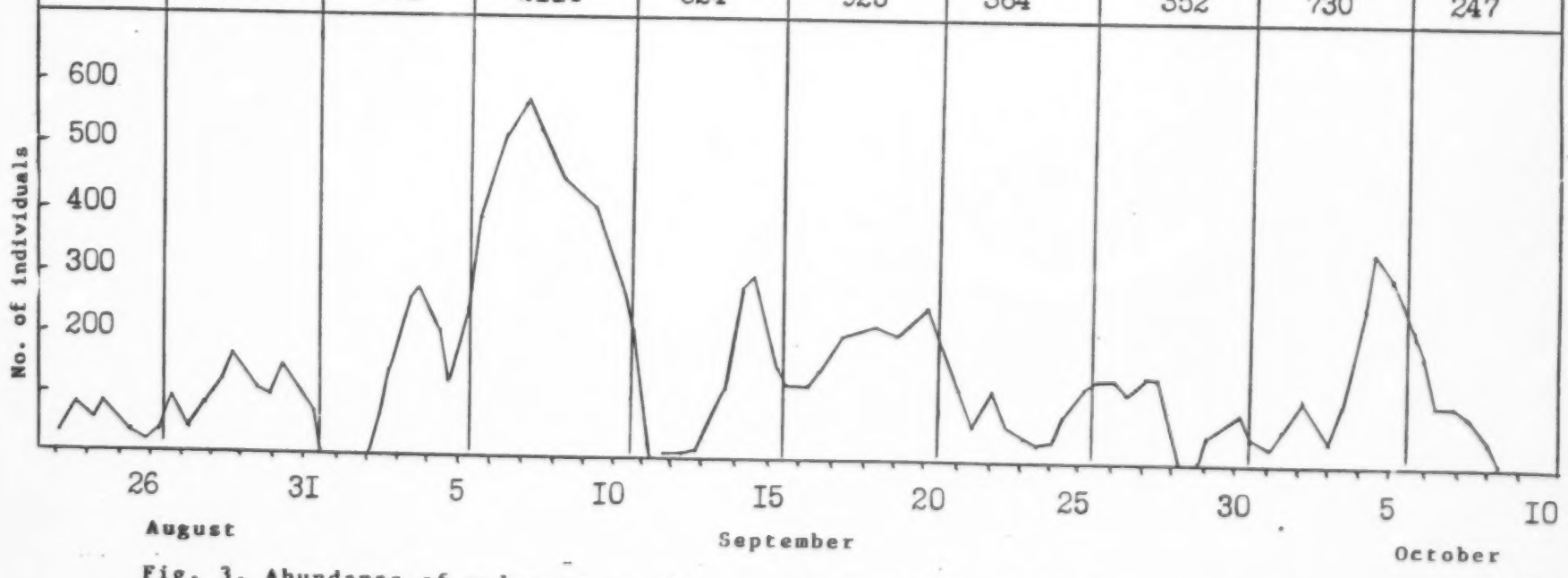

Fig. 3. Abundance of walruses at the rookery during the 1985 shore season

The population dynamics of the walrus at the rookery were affected to some extent by the precipitation (during the clean-water period $r = -0.26$, $P<0.05$), and by the strength and direction of the wind. A strong wind and precipitation interferred with the hauling-out of the walruses, though with an offshore wind, when the ice was carried far out into the sea, even if it rained or snowed at the time, the tired animals still hauled out on shore, their numbers increasing to 300. In the case where several negative factors took effect simultaneously, all of the animals returned to the sea (on August 26—27th, the pressure decreased drastically and steadily, a strong easterly wind brought in an abundance of pack ice, and the concentration of the latter increased to 6 points). On the other hand, in the case where all the factors produced a favorable effect, the number of animals at the rookery reached 600 head.

The observations of 1985 confirmed that meteorological and ice conditions do influence the formation of the rookery both at the initial stage, and throughout the entire season (Fig. 3).

This relationship between climatic factors and the hauling out of walruses on shore is worth taking into account during aerial walrus surveys. At the rookeries of the western sector of the Laptev Sea, the largest number of animals can be expected after strong or persistent westerly winds, under conditions of steady or increasing pressure, and in the absence of precipitation.

The effectiveness of rookery utilization by walruses is reflected in the occupancy index of a rookery, which takes into account the number of hauling-out walruses and the length of time spent by them at the rookery (walrus/day). During the 1984 observation period, the occupancy index of the rookery peaked at the end of the first ten days of September, and in 1985 at the same time (Figs. 2, 3). Proceeding from questionnaire data, we can also assume that another, even stronger occupancy peak occurred during the third 10-day period of September.

The rate of increase or decrease in the number of walruses at the rookery was closely related to its functioning phase (Fig. 4). In 1985, the smallest interval between the animals approaching the shore or leaving it was noted for the period of maximum abundance of the animals (3—10 September). On the days of active departure of walruses (September 4th

and 10th), an average of up to 20 walruses left the rookery per hour, and on the days of rapid increment of the numbers, up to 15 walruses approached the shore per hour. For the season as a whole, beginning from the middle of it (September 12th), we noted a drop to 3—5 walruses/hr in the intensity of haul-out and departure.

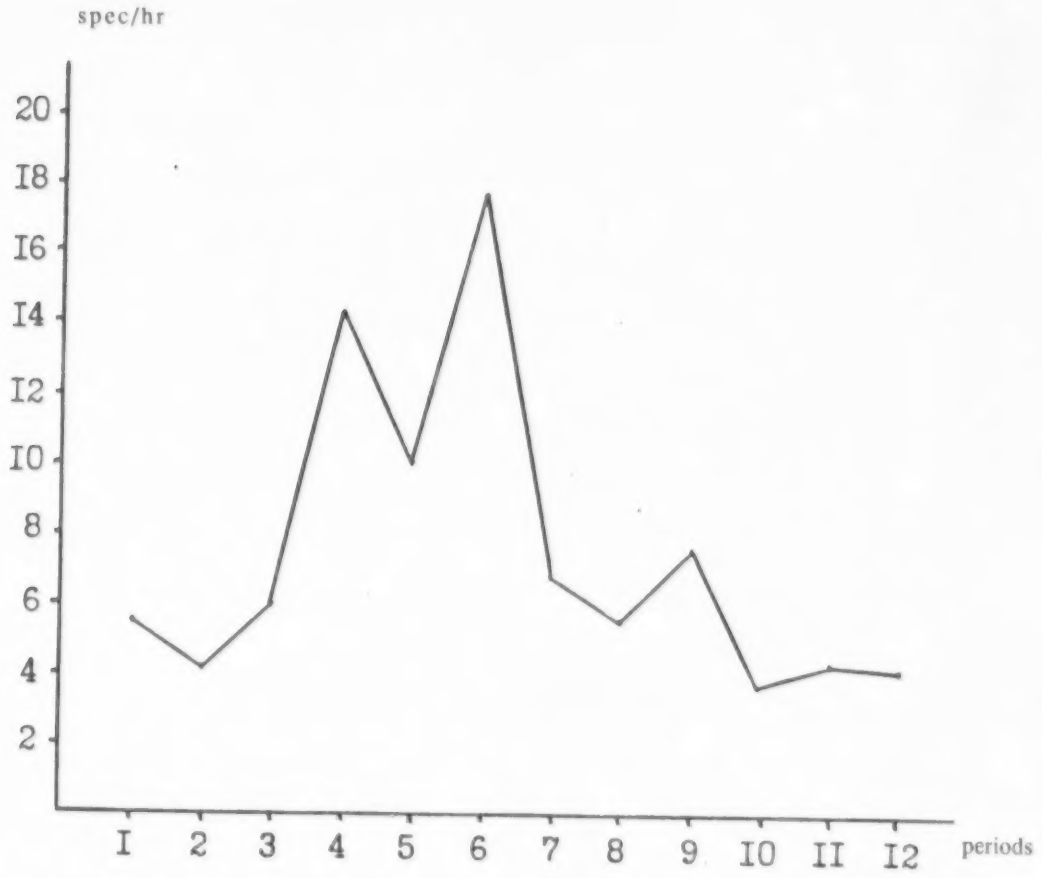

Fig. 4. Intensity of walrus haul-out and departure from the rookery in 1985 (total for each of the 12 periods)

Duration of the shore period and recurrence of walrus haul-outs. The duration of the rest period on the shore depended on the individual characteristics of the animals, as well as on the length of time spent away from a solid substrate. When the rookery was first formed in 1984, not a single walrus went back into the water for 36 hours; an adult male walrus was the first to leave. All of the females and first-year pups that hauled out on the first day also spent at least two days on the shore, but after that they rarely stayed at the rookery for more than 24 hours. Observations of "marked" walruses in 1985 enabled us to establish that the duration of the rookery period varied from 0.5 to 3.5 days, and differed on the average for female and male walruses (Fig. 5). During the season, the average duration of the rookery period also varied; it peaked in the males (1.7 days) at the end of the season, and in the females (up to 2 days) in the second one-third of the season, and then decreased again.

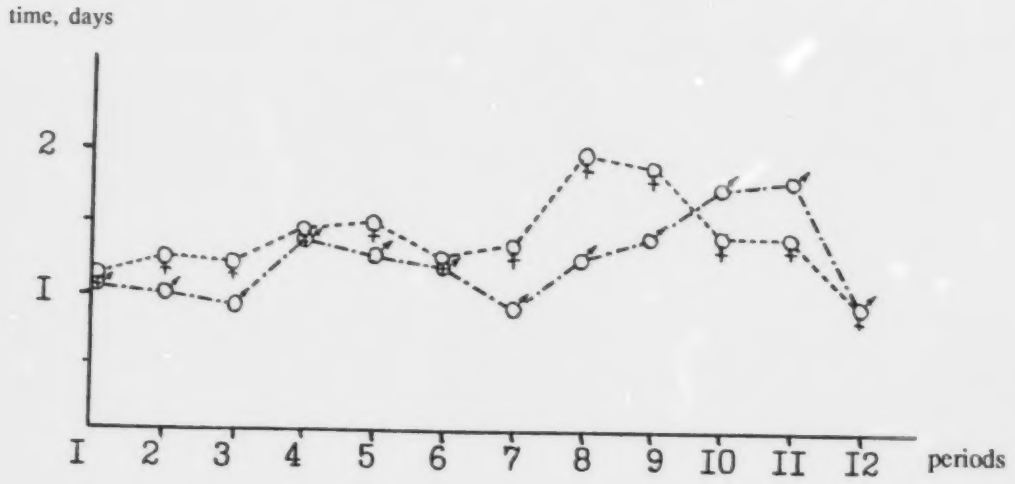

Fig. 5. Average duration of the rookery period for "marked" walruses in 1985 (total for each of the 12 periods)

----♀---- - females
-·-·-·-♂-·-·- - males

Of the 32 marked male walruses, only 5 (15.6%) hauled out twice. The females were characterized by a much stronger attachment to the given rookery; 9 females hauled out on the sand bar twice, 8 hauled out three times, and one female four times, i.e. 41.9% of the marked female walruses hauled out more than once. Both male and female walruses returned to the rookery from the sea mostly after 5—7 days (40.5%) and 15—17 days (18.9%). The marked walruses rarely hauled out again during the same peak of animal abundance (15% of the cases). A second haul-out usually occurred during the following peak of abuncance (62% of the cases), less commonly during the peak after that (20%); a second haul-out was once observed on the 25th day, i.e. two peaks later.

Sex—age structure of the rookery

Throughout the observation period, female walruses with their pups up to three year of age were the most abundant at the rookery (Table 1). The ratio of different age and sex groups gradually changed in the course of the seasons. At the end of the season in 1985, the proportion of females with first-year pups decreased by one-half, and the number of adult males sharply increased (Fig. 6). In 1984, despite the fact that the shore season of the walruses was only partially observed, analogous, though much more weakly defined tendencies of change in age and sex composition were noted at the rookery (Table 1). On the whole, a greater number of adult and old males, signficantly more submature individuals and fewer females with first-year pups hauled out in 1985 as compared with the previous season.

Each time when a new haul-out began after a drop in abundance, not many females with first-year pups hauled out at the initial stages. During the first formation of the rookery on July 27—28th 1984, the groups of walruses hauling out first did not include any females with first-year pups. During the second formation of the rookery, the first female with first-year pups hauled out when there were already about 40 walruses lying on the sand bar. During this period (August 28th—31st), the approach of female walruses with first-year pups had the following pattern of

distribution: 8% of the total number of hauled-out animals on August 28th, 24% on August 29th, 15% on August 30th, and 20% on August 31st.

Table 1. Sex—age structure of the walrus rookery in 1984—1985

Sex-age groups	No. of walruses (%) in 1984		No. of walruses (%) in 1985			
	17-26/8	28/8-6/9	23-31/8	2-10/9	13-21/9	22/9-2/10
Males (incl. the aged)	13.0 (1.0)	16.9 (1.3)	16.8 (3.3)	22.5 (4.7)	23.7 (6.2)	29.1 (10.5)
Females without pups	26.9	23.4	17.3	16.1	22.7	21.8
Females with pups	25.6	23.5	19.6	18.2	16.1	11.2
Young of the year	11.8	6.7	2.8	2.1	3.3	1.4
1—3-year-old pups	15.9	19.0	17.8	17.6	13.3	11.2
Submature walruses	6.8	10.5	25.7	23.5	20.9	25.3
Total	100	100	100	100	100	100

During the period of stable abundance of the rookery, the female walruses with the young of the year returned to the water and then hauled out again more frequently than the rest of the walruses. During these periods, the females and the first-year pups constituted up to 26—30% of all the hauling-out and departing walruses, whereas they comprised not more than 15—20% of the animals at the rookery (in 1984). This is apparently due to the higher than usual food requirement of the nursing females. They have to go out into the sea more often and then return again to nurse their young, for it is more convenient to do so on land; only once did we spot a yearling attempting to suckle in the water.

The walruses approaching the rookery kept to themselves and in family or superfamily groups of 2—9 animals; larger groups of up to 15 walruses were also noted several times (Fig. 7). During the second half of August 1984, the walruses hauled out predominantly in groups of 2—5 individuals; during the period from August 28th to September 6th, the groups became larger (Fig. 7). In 1985, we did not note any changes in the

abundance of the groups during the season, and, compared with 1984, the groups were usually smaller, i.e. about 60% of the animals hauled out in groups of up to 3 (Fig. 7).

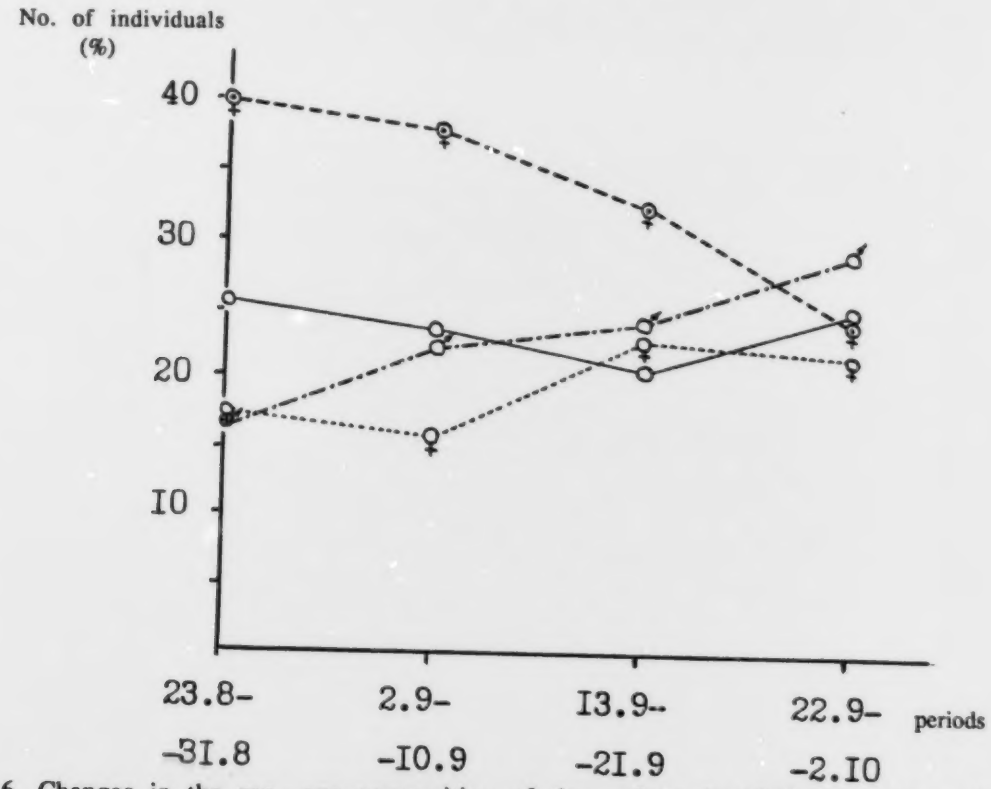

Fig. 6. Changes in the sex—age composition of the rookery in 1985 (total for each of the four periods)

---♀--- - females with pups
·····♀····· - females without pups
-·-·♂-·-· - males
----o---- - submature walruses over 3 years of age

Among the solitary animals, females without pups prevailed in 1984, while males, less commonly sexually immature individuals over 3 years of age hauled out one by one in 1985 (Figs. 8, 9). The old males preferred to remain solitary, or in a pair with a submature male or female walrus. Females with pups were the most abundant in all the groups. Females with yearling pups were very rarely encountered in large groups (7—9 walruses); females with pups over a year old prevailed in these groups. In

1984, the number of females with 1—3-year-old pups was particularly high in the large groups of animals at the end of the observation period.

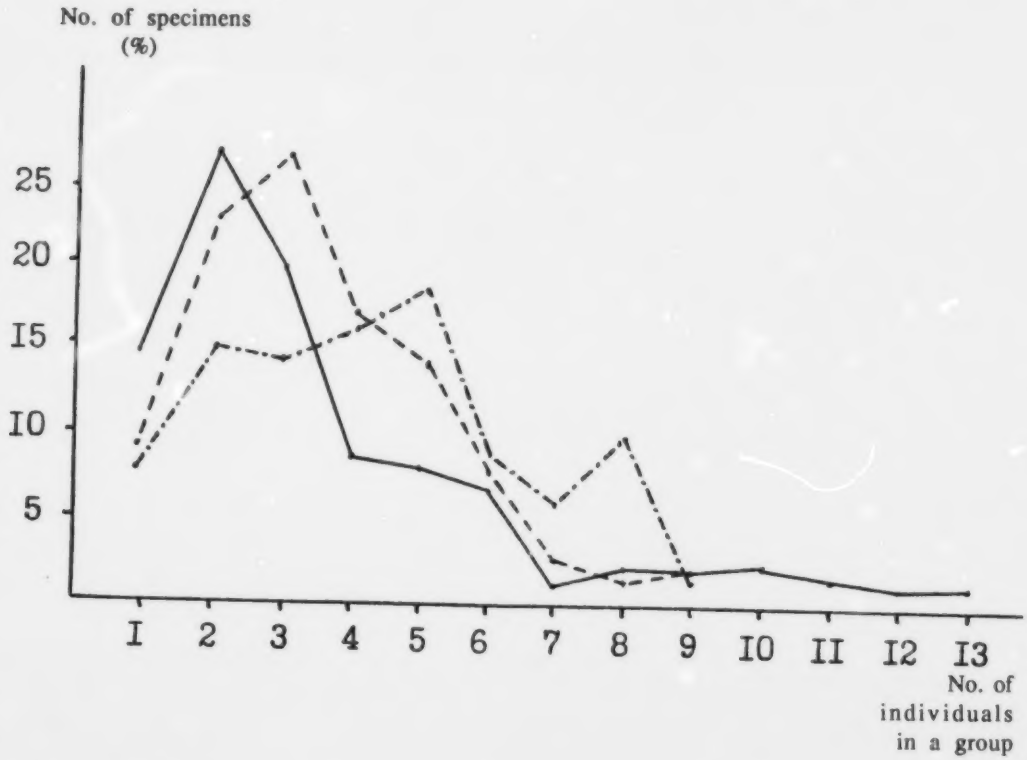

Fig. 7. Distribution of walruses according to groups of different size

-------- - 17—26 August 1984
---------- - 28 Agust to 6 September 1984
---------- - 1985

Walrus behavior at the hauling-out grounds and the effect of the disturbance factor on the animal. The behavior of the walruses at the hauling-out grounds depended both on their individual characteristics, and on the sexual and age composition of the rookery. The hierarchical rank of an individual was determined by the sex, age and aggressiveness of the animal, and in the case of the females, also by the presence of a first-year or year-old pup. The animals emerging from the water lay down mostly along the periphery of the rookery, crowding 2—3 of the closest walruses. Certain individuals, usually the dominant ones, tried to move farther into

the midst of the rookery, but this was never attempted by the females with first-year or year-old pups. In search of a more comfortable spot, the females with first-year pups often circled the entire rookery; in these cases, the pup always stayed between the mother and the rookery. The submature individuals also could not find a spot for themselves immediately; having reposed, they were often driven away and crowded out to the periphery of the rookery by older animals. The first-year pups, and often older ones, tried to find a place on the back of the mother or any other neighbouring walrus, where there was a smaller risk of getting crushed. When in the water, the first-year pups quite often stayed on the mother's back as well.

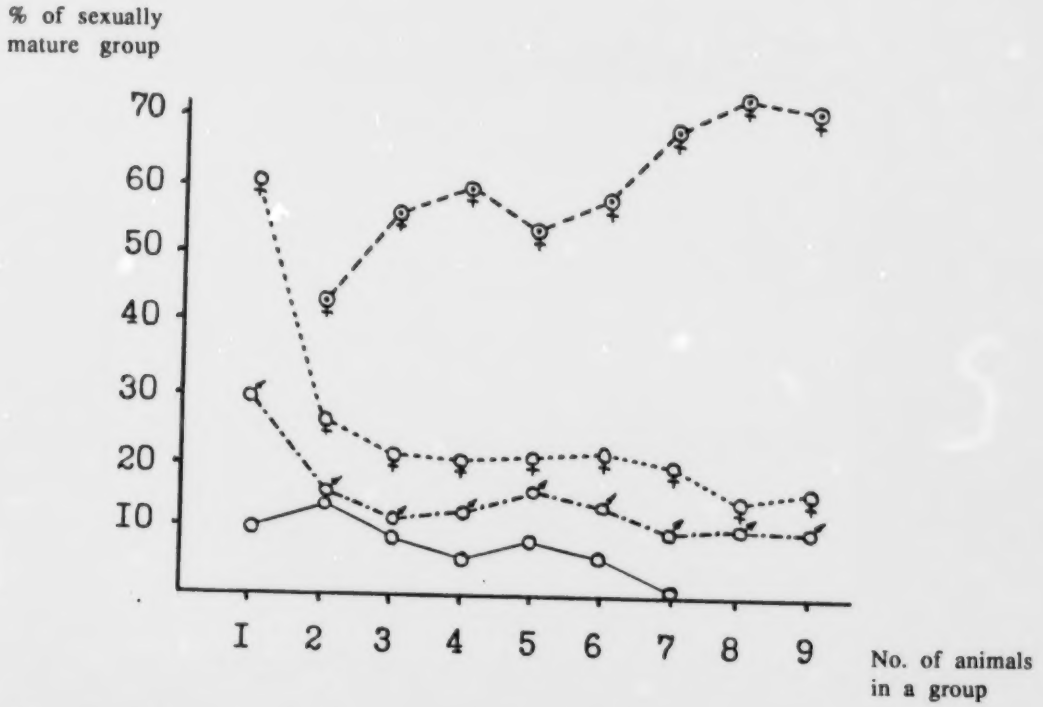

Fig. 8. Sexually mature content of groups of different size in 1984

---♀--- - females with pups
·····♀····· - females without pups
-·-·-♂-·-·- - males
----o--- - submature walruses over 3 years of age

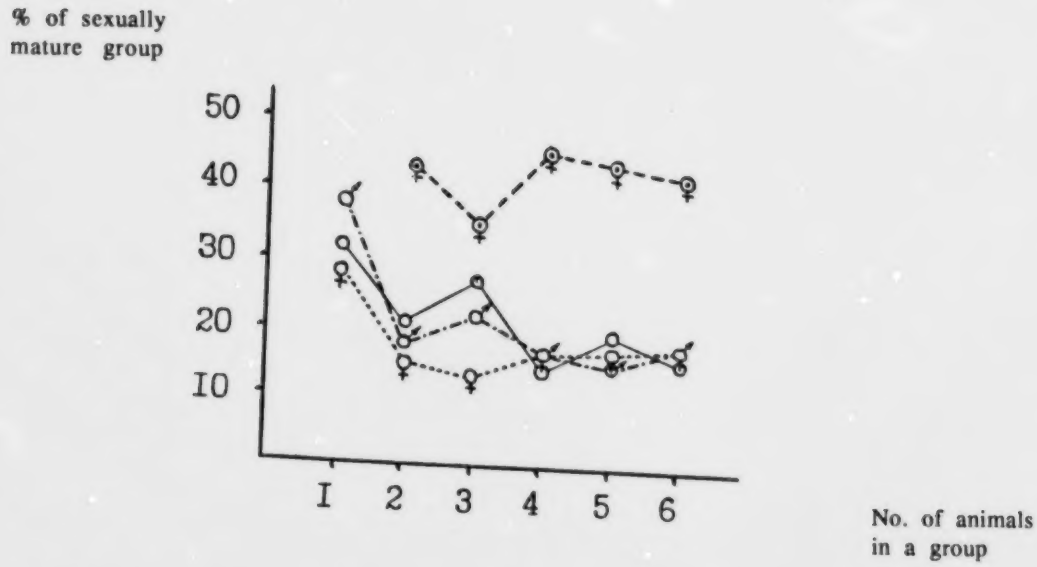

Fig. 9. Sexually mature content of groups of different size in 1985

---♀--- - females with pups
·····♀····· - females without pups
-·-·-♂-·-·- - males
----o--- - submature walruses over 3 years of age

Aggressive behavior towards first-year pups on the part of adult walruses was not noted a single time in a rookery formed basically of females with pups of different age. Moreover, during struggles between adult animals, the first-year pups nearby were never even accidentally grazed. This relationship between the adults and pups apparently exists only at coastal pup rookeries. At certain stages of the rookery in 1985, when the number of females with pups was relatively small, we noted several cases of aggressive behavior towards the pups on the part of the male walruses. At male rookeries which are occasionally come upon by a female with pups, the male walruses show no leniency towards the pups (Lisitsyna, 1978).

As we know, female walruses show a deep affection for their pups. We know of a cases where the mother "defended" her underyearling pup even when it was playing with another pup of the same age. At the same time, when her pups attempt persistently to reach her nipples to suckle,

she does not assist them in any way, nor does she occupy a pose to accommodate the feeding.

We were able to observe the feeding of first-year pups at all times of the day and night, one feeding lasting 35 minutes at the most. In many cases, the pups did not get their fill of milk; in some cases, the mother turned away so that the pup could not get at her nipples, and in other cases, the milk ran dry shortly after the pup began to suckle, and the pup began to try other nipples. Based on two seasons of observations, less than 20% of the first-year pups suckled longer than 25 minutes. One case of a 2—3-year-old suckling was noted.

Nuptial play in the water and mating were observed almost every day from August 8th to September 4th in 1984, and on August 24—26th and September 10—17th in 1985, 40 times altogether. On certain days (August 17th, 18th and 23rd 1984), we observed up to 3 pairs mating at the same time. In the majority of cases, the walruses displayed nuptial behavior in shallow water close to shore, and only in 7—8 cases more than 20 m from shore. Copulation of walruses was recorded twice, in the tidal zone at a depth of 0.5—0.7 m. Copulation lasted 20—25 seconds. Mostly young animals took part in nuptial play. In some cases, male walruses pursued fairly large, but still sexually immature females about 3 years of age that hauled out with their mothers. The majority of males attempted to mate with 2—3 different females, which confirms F. Fay's data on the polygamy of walruses (Fay, 1981).

The walruses departing from the rookery sometimes moved very slowly and hesitantly towards the water, and then stopped half-way and fell asleep. In these cases, they usually became the nucleus of a new rookery, i.e. some of the animals that hauled out again lay down alongside them. Therefore, besides the main group of walruses, we could sometimes see another 1—2 small groups nearby. We were unable to establish any regularity in the sex and age distribution of walruses in the large rookery and the neighboring small ones.

The behavioral repertoire of the walruses in the water was quite varied, but its was, for the most, concealed from the eye of the observer on land. Most of the walruses were seen when they made their way along the sand bar to and from the rookery. Under calm conditions, the walruses

swam for long periods, holding their head above water and inspecting the sand bar. The young of the year swam at their mother's side or stayed on her back, and always dove together with her, less than a second later. Frightened walruses or those trapped in close pack ice could dive underwater for a distance of up to 250 m. A walrus sleeping in the water in a vertical position was seen only once.

Some walruses foraged in the shallows close to the rookery. We observed, among other things, a young walrus feeding on *Laminaria* in the tidal zone; it pushed aside the pebbles covering the leaves with its snout, and then vigorously sucked in the leaves. The walruses reacted differently under different conditions to the activity of humans on the sand bar in the vicinity of the rookery. Reposed animals remained practically undisturbed by the slow leeward approach of man; the animals allowed us to approach them within a distance of up to 12—15 m, and then crawl another 1—2 m. In August 1984 and September 1985, a helicopter crew and part of a supply ship's crew landed on the sand bar to observe and photograph the walruses. In these cases, we had to accompany the groups to make sure that their approach to the rookery did not disturb the animals too much. The appearance of careless observers at the rookery, particularly during its initial formation, resulted in the departure of some of the animals, primarily females with their pups and juveniles. The same result was produced by the appearance of dogs at the rookery; the dogs barked at the reposing walruses, and many of them went back into the water. On 21 September 1985, the barking of two dogs at the rookery for 3.5—4 hours sent most of the animals back into the water; of the initial 120—130 walruses, about 50, predominantly adult males, remained at the rookery.

Twice we observed the passage of large-capacity vessels along the strait; they travelled slowly, and both times lee shore, and this did not appear to disturb the animals at the rookery. Many times (up to 10—15 times a season) we observed helicopters (Mi-8) and ice-survey planes (Il-14) flying overhead. In the cases where the flying altitude exceeded 400 m, no significant disturbance was noted at the rookery.

Conservation problems. The measures currently taken to protect many of the aquatic animals, particularly sea mammals, in the water areas of the USSR consist mainly in hunting restrictions or a ban. At the same time, the

problem of protecting the ecosystems in which these animals exist is pushed aside. This results in a chain reaction of numerous negative after-effects, beginning with water pollution and ending in disruption of the balance of species in the food chains and deterioration of the food supply for animals of the higher trophic levels. A great deal of harm is caused by the disturbance factor, especially at the breeding, moulting and foraging grounds.

In connection with this, the development of theoretical and practical principles of organizing sanctuary conditions in the water areas, on the islands and parts of the coast should take priority in the protection of aquatic animals. To ensure the protection of various species even within a taxonomically narrow group of aquatic animals such as the pinnipeds, different approaches to its organization are necessary. The pagophilic species of seals that breed amidst the ice require sanctuary conditions at their breeding and foraging grounds. The grey and monk seals that give birth on the shore require sanctuary conditions in these areas of land. In the cases where seals form moulting rookeries, these territories should also be protected, at least during the appropriate season.

Walruses occupy a special place among the pinnipeds. These animals keep to the relatively shallow areas of the sea (up to 50—70 m), since they feed on the benthos. The walruses breed amidst the ice and spend a large part of the year there, from July to October, when there is little ice left in the areas with depths accessible to them; the walruses haul out on land to feed their pups, rest and moult.

A pattern for developing a marine mammal protection strategy was proposed on the basis of the Pacific subspecies of the walrus (Ray et al., 1978). For the Chukchi and Bering seas, we have compiled diagrams of the places where pollutants run off from the shore, where oil and gas are extracted on the shelf, and where intensive fishing and navigation is carried on; we have also analyzed maps of the currents and the distribution of the organisms consumed by the walruses. By superposing all of these maps on the charts of the breeding and aggregation areas of walruses, the authors obtained a map of the ciritical places inhabited by walruses, and submitted proposals for introducing sanctuary conditions in these areas.

To develop protection measures for the pinnipeds found in the waters of the USSR, the Taimyr population of the Laptev walrus was taken as one of the models to study. The Laptev walrus has long been regarded as a scarce and poorly researched subspecies; its biology has not been studied by anyone over the past 30 years. With the current extensive development of the Far North, the measures that have been taken so far to protect the Laptev walrus do not guarantee its survival. To develop additional effective measures, we need information about the distribution of walruses, their population dynamics, as well as the biology of their reproduction and behavior in the sea and on coastal hauling-out grounds. The numerous questions that must be resolved in order to effectively protect the Laptev walrus population as a whole cannot be answered by studying the walruses that haul out at one rookery for the brief summer season. However, some of the aspects of the populational biology and ecology of the walruses can be cleared up even by this type of elementary investigation. Knowing the total occupancy of the rookery for the whole season (6674 walruses/day), the average length of time spent by the animals at the rookery (1.4 days) and the number of times individuals of different sex and age haul out, one can calculate that approximately 3000 (3378) walruses stayed at the rookery in M. Pronchishchevaya Bay during the season. Therefore, in addition to the fact that many of the walruses departed many times to forage and then returned again, there was, at the same time, a continuous change of the contingent, and a large part of the Taimyr population of walruses, possibly almost all of them, be it for a short period of time, utilized the given rookery.

The rookery plays a particularly important role for the breeding animals of the population; the dominant ones here where numbers are concerned are the female walruses and their pups; the females remain at the rookery longer, and they depart and haul out again many more times than the males, i.e. the females return to the rookery more frequently, and are more attached to it. The abundance of the females is particularly high at the beginning of the season; at the same time, we note an active change in the composition of the walruses and that a large number of animals utilize the rookery. By the end of the season, the walruses become more conservative in their behavior; they lie about for a longer time, depart and

haul out more frequently, and the intensity of their haul-out and departure decreases.

Our analysis of the status of the Laptev subspecies of the walrus, which is based on the literature (Koshkin, 1940; Uspensky, 1958; Popov, 1958, 1960; Fedoseyev, 1978, 1983) and the results of field observations, points to the extreme vulnerability of the subspecies. Despite the fact that only licensed hunting of the Laptev walrus has been in effect for thirty years now, the abundance of this subspecies has not increased. This is due to a number of factors: a low birth rate (according to different authors, the increment in its numbers varies from 11 to 17%); a close relationship with the ice, resulting in a higher mortality when the ice conditions deteriorate; the ever-increasing anthropogenic stress.

Having compared the ecological situation in the areas inhabited by different subspecies of walruses, we see that the Laptev walrus lives in particularly adverse conditions. From November to July, the entire sea is covered with ice, with relatively stationary polynyas found only in the vicinity of the Pyotr and Faddei islands and northwest of the Novosibirsk Isls. The least abundant ice cover during the year is observed in September, and averages 86% (Atlas..., 1980); however, there are years when the entire sea, with the exception of Khatanga Bay and the pre-estuarine areas of the Lena and Yana, remains under ice for the summer (Fig. 1). The annual fluctuations in air temperature at the sea surface are very high, averaging 32—36°C, and some years they reach 76°C. The biomass of the given fauna varies from 10 to 100 g/m^2, which is lower by an order of magnitude in comparison with the southern parts of the Chukchi and Barents seas. The northern part of the sea is very deep; walruses can obtain food from the bottom only in the southern parts, in the areas adjacent to the Novosibirsk Isls. and along the eastern coast of Taimyr (Fig. 1). At the same time, the ecological conditions in the southern areas, especially in the pre-estuarine parts of the Lena, Yana and Anabar rivers and in Khatanga Bay, have deteriorated as a result of the contaminated river run-off into the sea (Fig. 1). In the areas of major navigation routes, the walruses are exposed to the disturbance factor. During the summer—autumn period, the walruses are more dispersed over the sea area than in winter and spring; therefore, the losses due to

navigation are apparently less catastrophic in summer. After the introduction of year-round navigation, strict protective measures must be introduced for the Laptev Sea in order to prevent vessels from passing through the breeding grounds of the walruses and the areas where they gather at winter—spring polynyas (Fig. 1).

Coastal rookeries are the areas of maximum summer aggregation of walruses. The results of observations for two seasons and survey data on the abundance of walruses at the hauling-out grounds over the past six years convince us that the seasonal migrations of the walruses depend on the ice conditions. This was again confirmed by the results of V.P. Pchelin's observations in 1986. This particular year was characterized by severe summer and autumn weather conditions (low temperatures, persistent rising winds). As a result, the amount and concentration of ice along the eastern coast of Taimyr were so high that the walruses were practically prevented from hauling out. Only at the end, in September—October, did we manage several times to see a small number of animals (50 at the most) at the hauling-out grounds.

When the approaches to one rookery are blocked by ice, the walruses make their way to another rookery. Under the difficult ice conditions of the Laptev Sea, the walruses must be able to utilize any one of the rookeries to the fullest extent. Some of the rookeries (on the Andrei, B. Begichev and Preobrazheniye islands) have practically ceased to exist due to anthropogenic stress (Popov, 1960; Vishnevskaya, Bychkov, 1985). In order to preserve the Laptev walrus, we must determine the whereabouts of all the degenerating and the normally functioning rookeries, and to ensure the existence of an efficient system of coastal and island rookeries by establishing sanctuary conditions there for the summer—autumn period. Among other things, the only large, regular, mixed coastal rookery in M. Pronchishchevaya Bay on the mainland in the western part of the Laptev Sea should be made a sanctuary.

Observations on certain groups of walruses in winter have shown that animals of different sex and age are nonuniformly distributed in the wintering areas. According to the observations of polar-station worker V.P. Petrova in the vicinity of Heiberg Is. (Vilkitsky Strait), three groups of 7, 9 and 12 walruses, all young female and male animals, apparently sexually

immature and over 3 years of age (tusks up to 10 cm long), overwintered 200 m from the shore of the island (over a depth of 8—10 m) in 1986—1987.

At the initial stage of the work directed at preserving the species, we must define more accurately the boundaries of the water areas where the breeding and aggregation of the walrus takes place in winter and spring, and establish sanctuary conditions there for these periods. The further study of the winter aggregations of the walrus and its summer distribution at the rookeries and throughout the Laptev Sea will give us a better understanding of the many aspects of the biology and intrapopulational structure of this subspecies, and will help us preserve it.

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